A NEW ANT INQUILINE FLOWER FLY (DIPTERA: SYRPHIDAE: PIPIZINAE) FROM AUSTRALIA

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Abstract

Trichopsomyia formiciphila sp. n., a new ant inquiline flower fly, is described from eastern Australia. It has been reared in association with weaver ants of the genus *Polyrhachis* (*Cyrtomyrma*) Forel, in the nests of which its larvae are probably brood predators.

Introduction

Flower flies are abundant, conspicuous and varied. The adults are pollinators and the habits of the immatures are diverse, ranging from larval predators of various homopterous pests to filter-feeding rat-tailed maggots, with some specialised predators of ant brood (Rotheray and Gilbert 2011). More than 6200 species have been described (Thompson 2013). While our knowledge of the flower fly fauna of Europe is rich, very little is known of the Australian fauna. The last significant work on this fauna was completed in the 1920s and 30s (Ferguson 1926a, b, Hardy 1933), with a few revisionary keys published since (Riek 1954, Paramonov 1955a, b, 1957a, b, Thompson 1968, Wright and Skevington 2013, Mengual and Thompson 2015).

The association of flower flies with ants is mainly limited to species of the subfamily Microdontinae, all of which are inquilines as larvae. Beyond these and the species herein described, very few other species are known to be ant inquilines: some species of *Chrysotoxum* Meigen (Rotheray 1993: 70) and a species of *Platycheirus* Lepeletier & Serville from New Zealand (Thompson 1972). The first published record of the relationship between *Polyrachis* Fr. Smith ants and *Trichopsomyia* Williston was made by Hölldobler and Wilson (1990).

Materials and methods

The terminology used follows Thompson (1999), which was derived originally from the *Manual of Nearctic Diptera* (McAlpine 1981). This is congruent with the terminology presented by Cumming and Wood (2009) except some terms used for the male genitalia that follow the latter.

For details concerning the collection and processing of the host ant nests in Townsville, together with the isolation and recording of their arthropod associates, including the syrphid material from this source contributing to this report, see Downes (2015).

Abbreviations used here include: AM – Australian Museum, Sydney, Australia; ANIC – Australian National Insect Collection, Canberra, Australia; BMNH – Natural History Museum (formerly British Museum (Natural History)), London, United Kingdom; CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada; JSS – Jeff Skevington specimen; QM – Queensland Museum, Brisbane, Australia; QMT – QM_REG._NO._T (Queensland Museum registration numbers appear on labels in this format, shortened to QMT throughout the text); USNM – National Museum of Natural History (formerly United States National Museum), Washington DC, USA.

DNA extraction, COI amplification and sequencing followed the methods outlined in Skevington and Thompson (2012). GenBank numbers are provided in the material examined list after the relevant specimens and begin with the letters KX (*e.g.* KX586304).

Systematics and biology

Trichopsomyia Williston

Trichopsomyia Williston 1888: 259. Type species: *Trichopsomyia polita* Williston by subsequent designation of Hull (1949: 330).

Diagnosis: A flower fly genus of the subfamily Pipizinae (face without an oral notch and pilose, eye pilose, facial groove (anterior tentorial) reduced to small circular pit; crossvein r-m basal, at basal 1/4 or less of cell DM) with anterior anepisternum pilose.

Triglyphus Loew and *Trichopsomyia* are the only pipizines with long erect pile on the anterior anepisternum. *Triglyphus* is easily separated from *Trichopsomyia*: as the name implies, it has only three well developed abdominal segments, whereas *Trichopsomyia* typically has four well developed segments.

While the genus was originally based on two species from Brazil, it is now known from all biotic regions except the Afrotropics (Palaearctic (6), Nearctic (11), Neotropics (12), Oriental (2 undescribed), Australian (1)). This first species from the Australian region is described below.

Previously, the biology of only one *Trichopsomyia* species was known and that species is a larval predator of psyllids in their galls (Rotheray 1993: 90). The new species described below was found in ant nests where the flower fly larvae are probably brood predators.

Trichopsomyia formiciphila sp. n.

(Figs 1-3)

Trichopsomyia 88-20 Thompson (1988 manuscript).

Trichopsomyia sp. Hölldobler & Wilson 1990: 510, fig. 13-27 (larva, puparium and adult female) [biology].

Type material examined. Holotype ♂, AUSTRALIA (QUEENSLAND): Mission Beach, summit of Bicton Hill, 17°50'S 146°6'E, 24.xi.2014, J.H., A.M. and A.W. Skevington, CNC374747 (KX586304 QMT207068 (in QM). *Paratypes*: 10 ♂♂, same data as holotype: CNC374740 (KX586306); CNC385009 (KX586307); CNC385010 (KX586305); CNC374739; CNC374741; CNC374742; CNC374743; CNC374744; CNC374745; CNC374746 (1 ♂ BMNH, 7 ♂♂ CNC, 2 ♂♂ USNM); 1 ♀, Bertie Creek (pump), 1 km Southeast Heathlands H.S., Cape York Peninsula, 11°46'S 142°35'E, 16.iii.1992, G. Daniels, M.A. Schneider, QMT220779 (in QM); 1 ♂, 1 ♀, Mount White, Coen, 13°58'S 143°11'E, 29.iv.1989, G. & A. Daniels, AMK404802; AMK404803 (in AM); 1 ♀, same data, JSS45806 (in AM); 1 ♀, Mount Cook, 15°30'S 145°16'E, 11.x.1980, D.H. Colless, USNM ENT249748 (in ANIC); 1 ♀, Shiptons Flat, 15°28'S 145°8'E, 17.x.1980, D.H. Colless, USNM ENT249746 (in ANIC); 2 ♂♂, 3 km NNW Palmer River Crossing, 16°4'S 144°47'E, 17.v.1989, G. & A. Daniels, AMK404804, JSS45805 (in AM); 1 ♂, same data except 19.v.1989, AMK404805 (in AM); 1 larva, Lake Eacham Visitor Centre, Atherton Tablelands, 17°17'9.60"S 145°37'44.40"E, 17.vi.2016, M Downes, *Polyrhachis monteithi* Kohout nest in groove of *Pandanus* leaf, larva was 8 cm inside the long thin nest (30x1x1 cm), nest was well occupied (39 alate queens, 172 males and 64 workers), but had only 8 larvae, no eggs or pupae, CNC583572 (KX946581: in CNC); 1 ♀, Baldwin Swamp Fauna Reserve, Bundaberg, 24°52'S 152°22'E, 3.iii.1978, H. Frauca, USNM ENT249747 (in ANIC); 1 ♀, Petrie, Brisbane, 27°16'S 152°59'E, *Polyrhachis* nest, 20.viii.1997, J. Warden, with puparial case (emerged 26.viii.1997), QMT222901 (KX586308: in QM); 4 ♂♂, 2 ♀♀, Windsor, Brisbane, 27°26'S 153°1'E, 22-23.ii.1997, C.J. Burwell, QMT222894 (KX586309); QMT222895; QMT222896; QMT222897; QMT222898; QMT222899 (in QM); 1 ♂, same data except 8.iii.1997, QMT222900 (in QM).

Other material examined. AUSTRALIA (NEW SOUTH WALES): 1 ♂, Lord Howe Island, 31°33'S 159°5'E, USNM ENT249889 (in ANIC). (QUEENSLAND): 1 puparium, Cranbrook, Townsville, 19°15'S 146°48'E, 10.vi.2013, M. Downes, CNC464849 (in CNC); 1 puparium, same data except 10.vii.2014, CNC464854 (in CNC); 3 puparia, same data except 19.i.2012, CNC464850; CNC464851; CNC464852 (in CNC); 1 puparium, same data except 29.ix.2009, CNC464855 (in CNC); 1 larva and puparium, same data except 8.i.2011, CNC464853 (in CNC).

Description. Length: body 7.8-10.0 mm; wing 6.5-8.0 mm.

Male. Head (Figs 1A-C) black; face shiny except white pollinose medial vitta, white pilose; gena narrow, black, black pilose, shiny on anterior 2/3, white pollinose posteriorly; frontal triangle shiny on ventral 2/3, black pollinose dorsally except narrowly white pollinose along eye margin laterad to antenna, black pilose on black pollinose area and narrowly dorsad to lunule, white pilose medially; lunule black; holoptic, continuity as long as vertical triangle; vertical triangle black, black pollinose and pilose; eye densely black pilose; occiput black, white pollinose and pilose on ventral 2/3, becoming shiny and black pilose dorsally; antenna orange on scape and pedicel, black pilose; basoflagellomere elongate, about 4 times as long as broad; ratio 1:1:4.

Thorax (Figs 1A-B) black; postpronotum brownish black, brown pilose; mesonotum shiny, white pilose anterior to transverse suture and broadly anterior to scutellum, black pilose medially; postalar callus brownish orange; scutellum shiny, black pilose medially, white pilose marginally; pleuron shiny, black pilose except anepisternum white pilose; plumula black; halter yellow; calypter with dorsal lobe black, ventral lobe white with black margin and fringe. Legs: black except pro- and metatarsi yellow and metatarsus yellow on basal 2/3 of basitarsomere, black pilose except pale yellowish-white pilose on pale areas; metatibia slightly swollen and arcuate.

Fig. 1. *Trichopsomyia formiciphila* sp. n., male: (A) dorsal habitus (CNC374747); (B) lateral habitus (CNC374745); (C) oblique frontal of head (CNC374745). Scale bars = 1 mm.

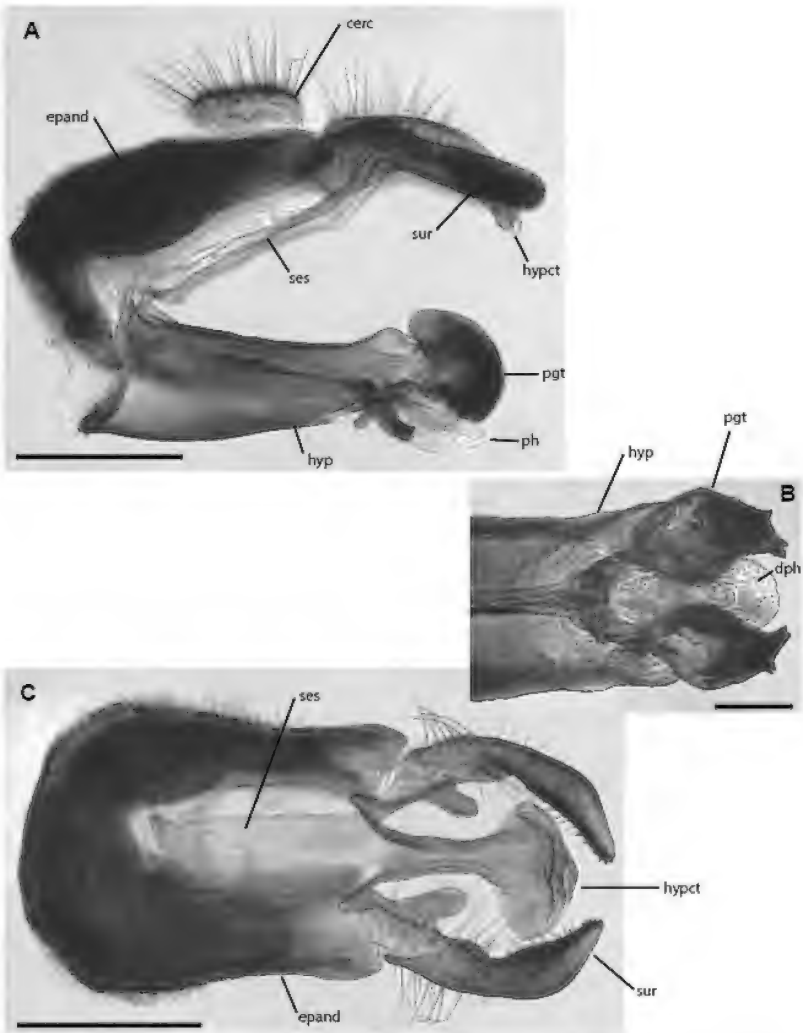

Fig. 2. *Trichopsomyia formiciphila* sp. n., male genitalia (CNC374745): (A) right lateral of terminalia, scale bar 0.3 mm; (B) ventral of phallus and associated structures, scale bar 0.1 mm; (C) ventral of surstyli and associated structures, scale bar 0.3 mm. Abbreviations: cerc – cercus; dph – distiphallus; epand – epandrium; hyp – hypandrium; hypct – hypoproct; pgt – postgonite; ph – phallus; ses – subepandrial sclerite; sur – surstylus.

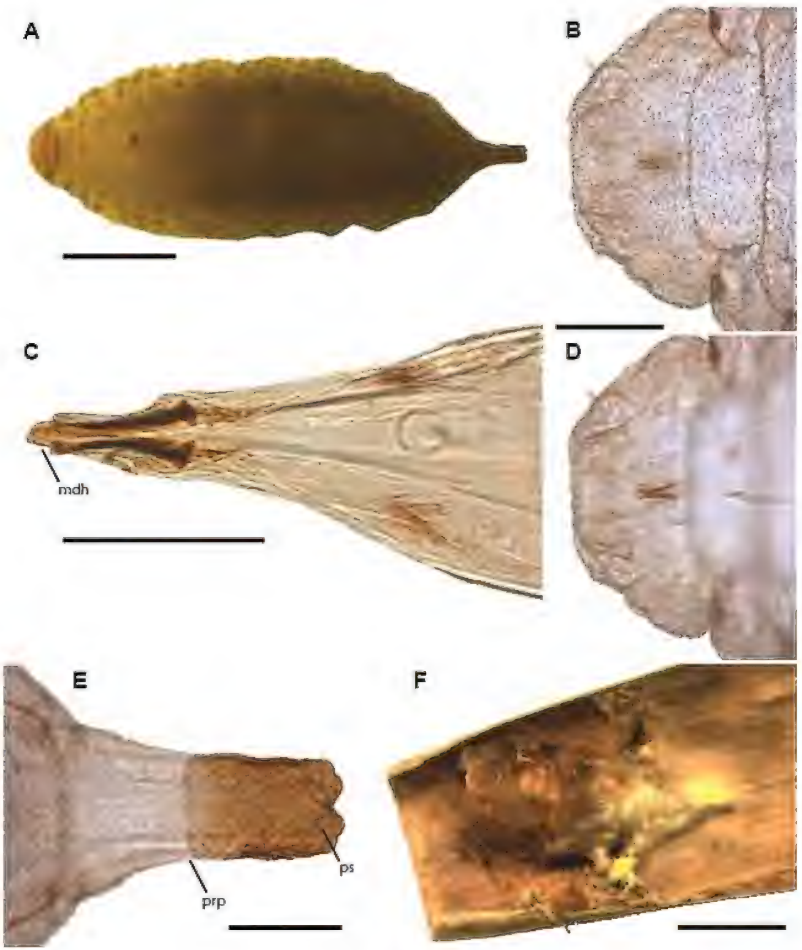

Fig. 3. *Trichopsomyia formiciphila* sp. n., larva and puparium: (A) dorsal view of live larva (CNC583572), scale bar 2.0 mm; (B) dorsal view of larval head (CNC583572), scale bar 0.5 mm; (C) ventral view of larval mouthparts (CNC583572), scale bar 0.2 mm; (D) ventral view of larval head (CNC583572), scale bar 0.5 mm; (E) dorsal view of posterior spiracles (CNC583572), scale bar 0.5 mm; (F) puparium *in situ* against the inner wall of a *Polyrhachis australis* nest; the remains of the nest wall (carton) can be seen along the inner lower edge; scale bar 4.0 mm. Abbreviations: mdh – mandibular hook; prp – posterior respiratory process; ps – posterior spiracle.

Wing diffuse brownish, microtrichose except bare as follows; basal 1/5 of costal cell, basal 1/3 of cell R, anterobasal 2/3 of cell M, anterobasal 1/5 of cell CuP [anal] and narrowly anterior to vein A2; alula microtrichose.

Abdomen (Fig. 1A) black; with two pair of large quadrate yellow maculae on 2nd and 3rd terga; 1st tergum dull black, white pilose; 2nd tergum dull (pollinose), with large yellow macula on medial 2/3, with macula slightly rounded on apicolateral half, white pilose on basal 4/5 except laterally, black pilose laterally and apically, except on basolateral corner long white pilose; 3rd tergum dull (pollinose), entirely black pilose; 4th tergum dull (pollinose) except shiny apically on apical 1/3 with submedial triangular extension to basal 1/2, black pilose except white pilose laterally. Genitalia: black, shiny, black pilose; surstyli C-shaped with basal protuberances and large central lobe (Figs 2A, C); postgonite kidney-shaped with stubby dorsal and distal prongs (Fig. 2B).

Female. Similar to the male except as follows: frons black, shiny except for two white pollinose maculae at mid length, black pilose; abdomen entirely black, dull pollinose except shiny where male yellow maculae are, white pilose lateral and on shiny area, elsewhere black pilose; 5th tergum black, shiny, black pilose.

Larva and puparium. Larva uniform olive-green without markings; mandibular hook three-lobed; posterior respiratory siphon 2.5 times as long as wide, darkly sclerotised on distal half (Fig. 3A-F).

Etymology. The epithet is the combination of 'formica' for ant and 'phila' for lover of. The name is an adjective.

Distribution. Australia (New South Wales, Queensland) (Fig. 4).

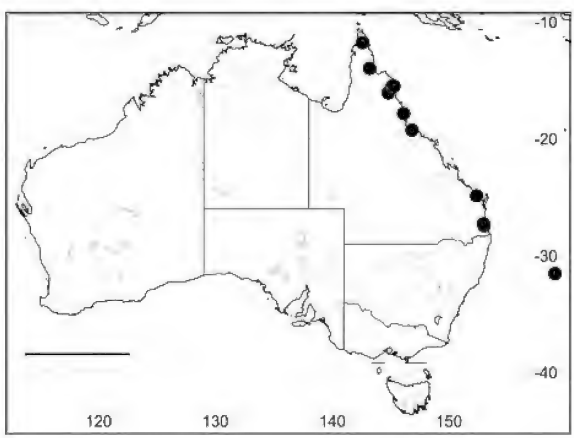

Fig. 4. *Trichopsomyia formiciphila* distribution. Scale bar = 1000 km.

Remarks. This species is readily recognized as the only *Trichopsomyia* known from Australia. It is similar to an undescribed species from Indonesia (a single male specimen from Kuala Lumpur collected by Pendlebury is in the American Museum of Natural History) and both species differ from other *Trichopsomyia* by the swollen and arcuate metatibia with a distinct thick brush of pile. They are mimics of stingless (trigonid) bees. *Trichopsomyia formiciphila* sp. n. has been reared in association with weaver ants of the subgenus *Polyrhachis* (*Cyrtomyrma*) Forel (Hölldobler and Wilson 1990: 510). The material collected by Hölldobler and Wilson should be in the Museum of Comparative Zoology but the specimens are missing and thus could not be included in the type series. Six specimens were DNA barcoded to test the species concept (COI 5' gene sequenced). QMT222894 and QMT222901 from the Brisbane area in South Queensland differed by only a single base pair from specimens collected near Mission Beach in North Queensland (CNC374740, CNC374747, CNC385009 and CNC385010). The Lake Eacham larva (CNC583572) was identical to sequences of Mission Beach adults. Sequence data could not be obtained from specimens from Cape York or Townsville (DNA degraded).

Table 1. Collection data for *Trichopsomyia formiciphila* puparia (and 1 larva) obtained from nests of the weaver ant *Polyrhachis australis* in Townsville. Volumes (cm^3) are of the ants' nests. Puparium sizes (mm) are given with and without respiratory horns respectively. NR = not recorded.

DATE	HOST PLANT	VOLUME	SPECIMEN	SIZE
29.09.09*	Umbrella	60	Puparium**	7.3, 6.9
18.10.09	NR	216	Puparium	8.9, 8.0
19.11.09	NR	240	Puparium	8.0, 7.0
08.01.11*	Umbrella	127.5	Puparium	7.6, 7.4
08.01.11	Umbrella	127.5	larva	(5.0)
11.02.11	NR	10.5	Puparium	7.0, 6.8
10.12.11.	Palm	8	Puparium	7.0, 6.7
19.01.12*	NR	192	Puparium	7.5, 7.3
19.01.12*	NR	192	Puparium	7.5, 7.0
19.01.12*	NR	192	Puparium	7.4, 6.8
05.10.13	Palm	8	Puparium	7.8, 7.0
22.12.13	Palm	13	Puparium	7.0, 6.7
10.07.14*	Palm	16	Puparium	7.6, 6.9

*Material taken by JHS for DNA analysis, stored in CNC; **Unbreached: dry remains of larva within.

Biology. In nests of the arboreal weaver ant *Polyrhachis australis* Mayr from Cranbrook, Townsville (19.302S, 146.751E), the inquiline's larvae were probably brood predators and its puparia were typically located on the innermost side of the nest wall, *i.e.* close against the silk lining of the nest carton, or on the inside of the leaf forming a nest wall, but were sometimes positioned deeper inside the nest or outside. All puparia occurred singly with one exception, when three were found in the same nest (19/1/12, Table 1). The host plants (umbrella tree and palms) primarily reflect the relative abundance of these plants and the ants' preferred host plants for their nests, rather than any propensities of the syrphids themselves. The dates of collection suggest greater activity in the summer (wet season) months but further specimens are needed to confirm this. Since only two of the puparia contained a larva and the rest were empty, a short metamorphic period is suggested. Again, future collections are needed to substantiate this. Some of the puparia appeared to be held to the substrate by an aggregate of silk strands forming a sheet (Fig. 3F).

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The order of the authors is alphabetical, all contributing equally to the manuscript: Downes collected the larvae, biological notes and associated data and contributed the larval figure; Skevington collected many of the adults, assembled the material examined, prepared the figures and coordinated the molecular data analysis; and Thompson contributed the traditional taxonomy.

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